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An Elementary Mathematics Curriculum Study to Determine if Achievement and Attitude can be Influenced by a Textbook Adoption

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AN ELEMENTARY MATHEMATICS CURRICULUM STUDY TO DETERMINE IF ACHIEVEMENT AND ATTITUDE CAN BE INFLUENCED BY A TEXTBOOK ADOPTION

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF THE TERMS USED

A part of curriculum planning and organization is the selection of textbooks. Textbook selection is not only the concern of administrators, but of teachers and students who will be using them. Textbooks are usually selected and chosen because of accuracy and mode of presentation, readability, organization, and completeness of content. This study is designed to determine if certain types of programs are more conducive to the development of positive attitudes toward mathematics and yet allow the student to maintain a level of academic achievement comparable or better than other programs.

There is on the market a wide range of contemporary mathematics textbooks available. Textbooks approach mathematics differently and there is a variation in terms of the amount of time allocated to a topic, the development of elementary concepts and laws of arithmetic, and the amount of drill and repetition. The sequential development of the texts follows closely, but the scope and content differ significantly.

Specifically, it is the purpose of this study to determine if there is a significant difference between series, as opposed to those in another mathematics series, in the variables of attitude and achievement. The two textbooks used in this study approach the teaching of arithmetic in a different manner, even though both are considered contemporary mathematics textbooks.

THE PROBLEM

Statement of the Problem

This is a curriculum study of textbooks. The study was made to evaluate a computer-based mathematics instruction text (Singer program) as compared to another contemporary text. It was the purpose of the study to test the following hypotheses:

1. Student achievement does not increase significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics program.

2. Student attitude toward the subject of mathematics does not increase significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics program.

Importance of the Study

Selecting and purchasing of textbooks is a major curriculum decision faced by all districts. It involves many facets and a knowledge of the whole area of curriculum and the latest in curriculum research as well as the current needs of each individual district. This study was a project commitment on curriculum, made by the Federal Way School District, to determine if textbooks influence attitudes and achievement of students. Three elementary schools from the district were involved in the data gathering process. All factors of the mathematics instruction were left unaltered, with the exception of the experimental school, which used the Singer program.

The implications of this study are important. Research has indicated that teachers' attitudes play an important part in affecting student attitudes, but the implications as to the possible effects of teaching materials has yet to be established. This study attempted to test the effects of textbooks on changing avoidance-approach responses of students.

The data for this study was obtained by taking a random sample of students in grades one through six from the three elementary schools in the study. The sample was large enough to be representative of a given population. Its findings should be applicable to other districts from similar communities.

There is a two year program commitment of the school district to obtain valid criteria for use in objective decision making regarding curriculum. The writer of this research paper used only the results of the first year of the study. This study will be made again, but in this paper no comparison has been made with the results obtained the following year.

Besides determining attitude change, this study determined if any significant gains were made in the area of achievement. Students in grades one through six were involved in the study, so it necessitated having an achievement measure suitable for all the elementary grades. The test selected was one that would not give unfair advantage to any one group. A test of just computational skills was chosen for use in this study.

Limitations of the Study

One hypothesis being tested in this study is concerned with the development of attitudes. It is not always an easy matter to determine if an attitude change has occurred. For the purpose of this study, a change of attitude was determined by student responses toward a closed form questionnaire. The answers to the questions were weighed in value. The tabulation of these responses was used later to test the hypothesis.

The diagnosis and evaluation of attitude responses must be considered with great care because attitudes are intangible. To be objective about attitudes, this problem was attacked on the basis of behavior toward or away from the response. To determine these responses an avoidance-approach tendency questionnaire was given at the beginning of the school year and again at the end of the year. Since no standardized attitude scales are available specifically for this purpose, the questionnaires had to be constructed. The ideas of Robert F. Mager, in his book, Developing Attitudes Toward Learning, were utilized as an important aid in constructing the questionnaires (14:69-81).

The sampling population for this study was too large and encompassed too many classrooms for each individual in the sample to be observed directly. It would have been beneficial to observe each student personally in the sample to see if he or she actually displayed observable behavioral changes. Since this was not feasible, this study relied on student replies in the questionnaires.

When this study was begun the random sample was selected and it included some alternates for each grade, to be used if the enrollment was not the same when the achievement measure and questionnaires were given. The study was intended to be controlled and the same population used for the two data gathering periods. Due to the unexpected change in the school population, the sample population of October was slightly different from the population of April. Some alternates were used in the April sample. Due to the fact that the questionnaires were not identified by name, the questionnaire and achievement test scores could not be pulled from the study.

DEFINITIONS OF TERMS USED

For the purpose of this study the following terms were defined.

Control Group

The two schools that were taught contemporary mathematics used the text, New Laidlaw Mathematics Program, under the authorship of Bernard H. Gundlach, Edward G. Buffie, Robert R. Denny, and Albert F. Kempt.

Experimental Group

The school that was taught contemporary mathematics used the Singer mathematics program, Sets and Numbers, by Patrick Suppes, Catherine Braithwaite, Dolly Kyser, and Marlene Schroeder.

Contemporary Mathematics

The term used to describe our current mathematics programs of instruction. This mathematics is characterized by new symbolism and progression of concepts developed to make the transition into the higher forms of mathematics a more continuous step.

Avoidance-Approach Questionnaires

These are questionnaires constructed and devised to evaluate students' attitudes toward or away from the area of mathematics.

Curriculum

The over-all organization of courses and activities of schools.

CBMI

This acronym denotes Computer-Based Mathematics Instruction.

CHAPTER II

REVIEW OF RELATED LITERATURE AND RESEARCH

The nature of this study is basically concerned with curriculum, but the scope of the study centers around the mathematics area. To best understand the nature of the problem, the review of related literature is concerned with current mathematics research as well as with the changing curriculum.

Current Curriculum Trends

Curriculum has always been in a process of change. New content has been added and material discarded. Gradual changes have been occurring in curriculum.

> At the end of World War II, however, the schools in the United States were ready for more sweeping change. The country had passed through some twenty years of economic depression and war; we had lost sight of education as a potent force for societal welfare, and had neglected our schools. The near absence of scientific and mathematical comprehension among school graduates, revealed by wartime testing programs showed that something was wrong with our educational institution (9:9).

Research has shown us that this great upsurge in curriculum reform occurred in the late 1950's and early 1960's with the greatest emphasis occurring around the time when Russia launched their first satellite. At that time our societal conditions were undergoing a great change. The world was advancing considerably in the era of scientific development.

To promote progress in the areas of science and engineering, Congress established in 1950 the National Science Foundation. This foundation promotes basic research by awarding grants and fellowships. Besides these fellowships and grants it also supports some institutes that provide training for high school and college teachers of science and mathematics. We also have another federal agency active in educational research, that being the United States Office of Education.

The federal government is expending large amounts of money for research in all areas of education, not only in the areas of science and mathematics. There is a number of pieces of federal legislation that have had an impact on education. Among these are the National Defense Act of 1958, the Vocational Education Act of 1963, and the Elementary and Secondary School Act of 1965.

The National Defense Act provides support for the subject fields of science, mathematics, modern foreign languages, and guidance with a limited amount going to support research in the humanities and the social sciences. This act also makes available educational loans, fellowships, and graduate improvement programs. The allocations for 1965 totaled approximately $270 million dollars (12:115).

The Vocational Education Act is designed to attack some of the problems of education by authorizing the following:

> . . . vocational education programs for persons in high school, for those out of high school available for full-time study, for persons who are unemployed or underemployed, and for persons who have academic or socio-economic handicaps that prevent them from proceeding in the regular vocational education program (21:42).

The Elementary and Secondary School Act has as its purpose helping the deprived child whose needs have not been adequately filled in our regular school classes. The current priorities are directed toward poverty areas, culturally disadvantaged, in-service training for teachers of the disadvantaged, projects for the handicapped, and Head Start (18:9-10).

There are also a number of large and small private foundations that support educational research. Among some of the larger and best known are the Ford, Rockefeller, Carnegie, Kellog, Sloan, Lily, Commonwealth, Duke, Hartford, and Sears foundations.

In the area of current curriculum reform, the earliest studies were concerned with the secondary schools. The emphasis was on attacking the curriculum problem from the top down with major emphasis on high school and gradually extended into the junior high levels. Currently the focus has changed and curriculum reform is occurring in the earliest years of schooling. Investigators such as Goodlad (16:359) have made the following suggestions regarding curriculum plans:

1. Be concerned with the curriculum sequence from the bottom up.

2. Move from a pattern of single subject to many subject studies.

3. Evaluate and test all materials, using children representing the various cultures.

4. Consider both the advantages and disadvantages of various styles of learning.

5. Research should be aided by University control laboratory schools to ensure design.

6. Be concerned with new styles for educating teachers.

Today we see a tremendous increase toward improvement of curriculum design as well as curriculum materials. Roberts cited various individuals and their views regarding educational research and design (16:353-361). Quoted below are some of the opinions:

> Clark, Klein, and Burks (1964) reported that most curriculum innovations were designed to cram information into pupils. Passow and Leeper (1964) voiced this contention in declaring that the knowledge explosion has seen such a moving down of topics traditionally taught in lower grades. Goodlad (1964), in a study of some 16 curriculum projects in eight subject areas, characterized the movement as having focused on single subjects--planned generally from the top down. He further pointed to the trend toward increased interest in improving our curriculum by constructing new courses and producing more effective curriculum materials (2:402-413).

Denemark (1965) identified four major trends in this vein: (a) to re-examine content of subject fields, especially the structure of knowledge and method of inquiry; (b) to view education at every level as a continuum from preschool to graduate school; (c) to be concerned with methods of inquiry, processes of thinking and learning, with emphasis on ways of getting data relevant to decisions students will need to make; and (d) to demand better coordination of education across school, community, and state boundaries while maintaining a flexibility needed to fit curriculum to the unique needs of a particular community (3:54-69).

Bruner (1963) foresaw these trends by suggesting a need for a theory of instruction as a guide to curriculum construction. He pointed to at least three important elements of such a theory: (a) consideration of the predispositions of children to learn effectively, (b) identification of the structure of the disciplines, and (c) determination of the optimal sequence required for learning (1:523-32).

We have come to what has been described as "a new era in our schools" (4:74). There is so much to learn today. Today more knowledge is available than anyone can possibly read or comprehend. According to Doll:

> . . . the nature of subject matter has come to the fore as a criterion of content selection, and thus curriculum improvements, for three major reasons:
>
> 1. Knowledge has exploded to the point at which it is necessary to select for teaching those items of knowledge that seem most significant, and to eliminate much that is inconsequential.
>
> 2. Subject specialists have recently had more to say about the nature of their fields, and about the teaching of these fields.
>
> 3. Experiments are being directed toward showing that subject-matter, old and new, can be placed in previously unthought of locations in the life space of learners (4:74).

The factors listed above affect our elementary and secondary school curriculum development and design.

Materials and methodology are being greatly changed. Programmed learning, computers, manipulative devices, cubicles, individual study labs are being tested and used. The trend is toward more adequately providing for individual differences and giving all children a chance at optimum development. Instead of talking about why children are failing, teachers, educators, and administrators are trying to determine how we can best reach all children. We are learning a great deal more about children's growth in the field of cognition.

The works of psychologists regarding children's cognitive development is strongly influencing curriculum development. Cognition viewed from the structure-process approach is defined as "the exercise of the higher mental processes, totally dependent upon but essentially different from organism's learning process." Intelligence, which embraces learning and cognition, is defined as "the organism's ability to adapt to increasingly complex and sophisticated genetic internal and external environmental situations and stimuli" (4:109). Their studies and ideas have had an implication on curriculum planning. With different insight into the developmental process we currently have revised some former ideas about grade placement of certain concepts. This is especially true in the area of mathematics.

Curriculum programs differ significantly depending upon whose views one takes. If we go according to the views expressed by Gagne, our programs would center around problem solving. Gagne stated his belief that ". . . the highest level of learning is problem solving. His proposed teaching sequence includes a tightly knit series of sequential learning tasks--building from lower level capacities toward problem solving" (11:644). If one then took a different view, that of Bruner, "A learner begins with a problem to solve. Through the process of solving the problem he will learn the necessary fundamentals because he needs them" (11:644). Piaget supported the age-stage development process (17:92-93). A child progresses through a series of sequential stages. He must pass through one stage before he can pass to another stage. Curriculum must be planned with these developmental stages as a guide line. Placement of concepts and skills at a certain stage corresponding to a child's development is imperative in good and effective curricular design.

The responsibility toward curriculum planning is changing. Curriculum planning is not something just left to the administrators. The responsibility should rest with teachers also. Teachers need to be involved more in curriculum decisions, because they are more familiar with their students' development. Teachers are called on to test concepts and try out curriculum ideas; therefore they should have a choice and be a vital part in the evaluation process.

Not all projects and curriculum research have greatly advanced our knowledge about curriculum. The main criticisms about current research are:

1. Many projects lack specific aims and objectives.

2. The lack of state or local direction to curriculum planning.

3. Poor evaluation techniques.

4. Some experiments are not really experiments, since they just compare the old with the new, rather than suggesting alternative ways and experimenting with them.

5. Not all projects provide a fresh look in curriculum theory (16:353).

The scope of curriculum research is changing. "Today the counter tendency is toward large-scale research with responsibility and leadership shifting from local to a greater geographical, social, or professional level" (8:48). Goodlad viewed curriculum research as following this path:

> The updating of curriculum content and material is now following a new route. Committees of specialists and teachers . . . supported by substantial foundation grants, are developing and testing, revising content, teaching procedures, and instructional materials. Their products are then produced by commercial publishers (12:114).

Trends in Mathematics

Research in mathematics is not a current innovation. Research projects were carried on, but not to the scale they are being carried on today. Most people were not as research oriented as educators are today. In the 1950's there was an awakening regarding education, especially in the areas of science and mathematics. The space age caused us to examine our educational system beginning with the science and mathematics areas, then expanding into all areas of education.

Beginning in the late fifties we can readily observe some new methods and changes of mathematics which emerged in our society. Montessori, Stern, Cuisinaire, Gattegno, and some others became common names in the educational field. These authorities came from abroad and brought with them approaches to arithmetic. The programs of these authorities are based on using manipulative devices and colors to develop basic understandings of how our number system develops.

Some of the more progressive schools experimented with these European approaches. Teachers were encouraged to take workshops or in-service training in the Cuisinaire method. Experimental programs were begun using these methods in districts that could afford to conduct this type of program and had trained personnel.

Soon these approaches steadily became less a topic of discussion, and we see an emergence of new texts, which have been constructed so as to provide more meaning and understanding of our number system. The recent trend toward greater emphasis on meaning is summarized by the following statement:

> People are coming to understand that pupils must be able to compute accurately and rapidly if they are to be capable of discovering mathematical principles, which is an important education goal of modern arithmetic programs (13:v).

The new modern mathematics program is the result of much research and background. Experimental research was being conducted as early as 1958. In 1958, the School Mathematics Study Group, under the direction of E. G. Begle, set about to determine how instruction could be improved. They found a definite need for a mathematics background which would enable students later in life to learn any new mathematics skill which our future demands . . . need for a program which offers not only basic mathematics skills but greater understanding of basic concepts and structure . . . need to attract and train more for the mathematics field . . . need for grade placement of concepts and principles (16:454-459). Once some of these basic needs were determined, then researchers and educators had to decide how to best fulfill these and many more needs.

The materials of the SMSG are probably some of the best known and widely used mathematics programs.

> SMSG courses are characterized by the treatment of relatively conventional topics rather than the introduction of new topics. Although students manipulate numbers the prime objective is to develop an awareness of the basic properties of mathematics (9:23).

In this way we still see a progression from the simple to the more abstract.

In 1959 the Educational Research Council of Cleveland sponsored the Greater Cleveland Mathematics Program. The purpose of this program was the development of a planned and sequential program of mathematics for grades kindergarten through twelve. S. R. A. materials have been developed by this group (9:23). These materials embody some of the current thinking in regard to the theories of learning.

In looking at current research areas and topics one can readily observe the growth in research studies testing the various theories of learning. Psychologists studying the cognition process have played a vital role in the development of current mathematics programs. Men such as Piaget, Inkelder, have enlightened us in regard to the placement of topics in mathematics. Regardless of tricks or gimmicks employed, a child cannot learn until his intellectual development has reached a certain point (18:99). We have changed our teaching techniques considerably and have a better understanding of the growth of logical sequence.

With this new approach to mathematics we see a great emphasis being placed on the language of mathematics. Our contemporary texts now introduce a symbolism to express concepts. This new approach to mathematics, which often is referred to as a "discovery" approach, shows greater reliance on manipulative devices to enable the transfer from concrete ideas to abstract ideas. Children are better able to proceed from one operational step to another. The new symbolism is a vital part of the development of current mathematics programs.

We have a large number of research articles being published in the professional journals and periodicals. Recently there has been a growing increase in studies testing the ideas of Piaget and others regarding cognitive development. Z. P. Dienes and M. A. Jieves (23:1-195) have been conducting a detailed study on the cognitive process that underlies individual behavior. They have completed a detailed study on the effects of certain relationships upon the transfer of learning for the age sample of 11-20. Dienes (24:1-313) has also written a book on the sequential steps of introducing the elements of mathematics.

Also currently of interest to many are the studies and work being done by Patrick Suppes. He is studying the use of the computer in mathematics instruction (21:303-9). He is also known for his construction and publication of a CBMI textbook series which is being used in this study.

Authorities have various views in regard to the direction current research and program implementation should take. Houston summated his ideas as:

> Implementation of contemporary programs depends to a large extent upon the understandings by teachers, and by teachers of teachers, of the strategies of mathematics education. This understanding is more than content presented in the same way or in different ways; it is the blending of current knowledge of psychology, of mathematics, and of educational methods into a viable program (11:643-4).

Glennon stated:

> . . . the . . . greatest need for improvement of elementary school mathematics program (in fact, any instructional program) is a theory of instruction implemented in the form of worthwhile research carried out and reported adequately by workers of integrity (7:368).

<u>Summary of Literature</u>

The upsurge in curriculum reform and new trends toward the teaching of mathematics have run parallel. The first attempts at curriculum reform centered primarily in the subject areas of science and mathematics. The approach of mathematics curriculum reform first centered in high school. Gradually the focus changed and it centered on the beginning school years. Approaches have been changing greatly during the 1960's. Curriculum design has been influenced by new theories of learning and different methodology used in teaching concepts.

Research and progress has advanced due to federal legislation, and federal, state, and private grants available for projects on educational research. All areas of curriculum are in a process of change and revision.

CHAPTER III

PROCEDURES

This was a project commitment concerning curriculum, being conducted by the Federal Way School District, 1969-70 school year. The writer was interested in doing a study in mathematics at the elementary school level. At the request of the school district, the writer has been working with the mathematics consultant, Mr. Jerry Ramsey, on this study.

Before beginning the project a procedural plan was determined. The goals, methods of acquiring the data, and target dates were established before the study was undertaken.

When the project originated it had as its goals to test the following null hypotheses:

1. Student achievement does not increase significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics program.

2. Student attitude toward a subject does not improve significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics program.

3. Teacher attitude toward a subject does not

increase significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics program.

4. Parental acceptance of the mathematics program does not improve significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics program.

Only two of the original hypotheses have been successfully researched. Those being carried out were the hypotheses relating to student attitudes and achievement. A survey of teacher attitudes has been made, but no comparison can be made because only one sampling of responses from teachers was obtained. This information will be used to help determine if avoidance approach responses of teachers in the control and experimental groups are similar.

Methods and Target

Three elementary schools were involved in the data gathering process. All factors of the mathematical instruction were left unaltered, with the exception of the school which used the Singer program. The teachers in this school received some guidance and information regarding the program from the textbook salesman at the beginning of the school year.

The target dates for gathering the measurement devices were scheduled for late September and early May, but these plans were altered somewhat. They were not given until early October and then again in late April. This represents a six month interim between the pre-tests and post-tests.

Selection of the schools to use in this study were on a voluntary basis. The teachers in the three schools agreed to cooperate in this endeavor.

Two different types of measuring instruments were used in this study: avoidance-approach tendency questionnaires and a standardized wide range achievement measure. To determine achievement, it was decided that the Wide Range Achievement Test (WRAT), put out by the Guidance Association, Wilmington, Delaware, would be used. See Appendix for a sample of the test measure used. The decision for using this measuring device was made by the mathematics consultant.

The other measuring devices were approach-avoidance measures. These questionnaires were constructed by the mathematics consultant and the writer, in order to best fit the needs of the study. They were a closed-form type of questionnaire and incorporated the ideas of Robert Mager (14:69-81) regarding the construction of avoidance-approach measures.

Sample

This was a systematic type sampling. In each of the schools involved in this study, children's names were arranged in alphabetical order according to each room, then grade by grade. From each grade, in each school, approximately five names were randomly chosen, plus two or three alternate choices. In this type of sampling all classrooms in each of the schools were involved and at least one or two pupils from each classroom were used.

Method of Presentation of Measurement Devices

The survey material was collected by the mathematics consultant and the helping teacher. They went to the schools and gave the achievement tests and questionnaires both in October and April. In the case of first graders both measures were given orally on a one-to-one basis.

Summary

An effort has been made in this study to obtain valid criteria to use in curriculum decision making. The sampling is small when considering a single grade level, but reliable inferences can be made if the grade levels are combined. The procedures in setting up this study have been described in detail. The procedures having been described in some detail leads into Chapter IV on the analysis of the data.

CHAPTER IV

ANALYSIS OF THE DATA

The study specifically is designed to determine if the null hypotheses hold true after the examination of all the collected data. Two separate hypotheses are being examined. All the data obtained was analyzed by means of a *t*-test (see appendix for formula) to determine statistically significant differences which might exist between the experimental and control groups. All statistical findings will be reported at the .05 level of confidence.

ACHIEVEMENT TEST RESULTS

The first hypothesis stated that no significant difference in achievement will be found between those students being taught using the Singer Mathematics program and those using the New Laidlaw Mathematics program. Table 1 presents a comparison of mean difference scores of the experimental and control schools for grades one through six. The obtained means show the amount of increase in grade equivalent scores that occurred in the six month interim between the pre-test and post-test of achievement. Each of the two experimental groups was compared separately against the control group.

Table 1

Mean Difference Scores of Experimental and Control Classes for Achievement Pre-test and Post-test Grades One Through Six

Group	N	Obtained Means	Obtained t	Required t
Control (1)	29	.55	.9531	2.000
Experimental	29	.49		
Control (2)	30	.65	2.365	2.000
Experimental	30	.49		

Table 1 shows that when comparing the experimental group with the control group (1) that there was a difference in obtained mean scores, but it was not found to be significant at the .05 level of confidence. When the experimental group was compared with the control group (2) the obtained means scores showed a significant difference existed at the .05 level of confidence. The control group excelled over the experimental group in achievement.

The mean difference scores of the experimental and control classes have been broken down into the grade levels of 1 and 2, 3 and 4, 5 and 6. A test of significance was run for each of these groups. The results can be seen in the Tables 2, 3, and 4 that follow.

Table 2

Mean Difference Scores of Experimental and Control Classes for Achievement Pre-test and Post-test Grades One and Two

Group	N	Obtained Means	Obtained t	Required t
Control (1)	10	.32	1.439	2.101
Experimental	10	.61		
Control (2)	10	.50	.5391	2.101
Experimental	10	.61		

It may be noted that Table 2 shows the mean difference in grade equivalent scores on the Wide Range Achievement Test for the experimental group and the control groups, grades one and two, during the six month interim between the pre-test and post-test. Even though the experimental group had a higher obtained mean score than either of the control groups the differences were not found to be significant at the .05 level of confidence.

Table 3

Mean Difference Scores of Experimental and Control Classes for Achievement Pre-test and Post-test Grades Three and Four

Group	N	Obtained Means	Obtained $\underline{t}$	Required $\underline{t}$
Control (1)	10	.52	.9322	2.101
Experimental	10	.35		
Control (2)	10	.70	1.501	2.101
Experimental	10	.35		

Table 3 indicates the mean difference in grade equivalent scores of the experimental and control classes, grades three and four. The control group (1) obtained a greater means score, but it was not significant at the .05 level of confidence. The second control group also scored a higher mean score, but the $\underline{t}$ test of significance showed this gain not to be significant.

By referring to Table 4, page 30, it may be seen that both control groups obtained a higher mean difference of grade equivalent scores for achievement than that of the experimental group in grades five and six, although there was no significant difference between the groups.

Table 4

Mean Difference Scores of Experimental and Control Classes for Achievement Pre-test and Post-test Grades Five and Six

Group	N	Obtained Means	Obtained t	Required t
Control (2)	10	.81	1.581	2.101
Experimental	10	.53		
Control (1)	10	.74	.7843	2.101
Experimental	10	.53		

The conclusions reached from the analysis of these statistical inferences are discussed in the following chapter.

AVOIDANCE-APPROACH QUESTIONNAIRE RESULTS

The second hypothesis being tested in the study stated that no significant difference in attitude will be found between those students being taught using the Singer Mathematics program and those using the new Laidlaw Mathematics program.

Table 5

Mean Difference of Experimental and Control Groups on October Pre-test of Avoidance-Approach Tendency Measure for Grades 1-6

Groups	N	Obtained Means	Obtained <u>t</u>	Required <u>t</u>
Control (1)	29	21.07	.0441	2.000
Experimental	29	21.02		
Control (2)	30	20.57	.4489	2.000
Experimental	30	21.02		

Table 5 shows the mean difference of the experimental and control groups on the pre-test of the avoidance-approach tendency questionnaire. A difference in obtained mean scores exists, but both the experimental and control groups show no significant difference at the .05 level of confidence. At the beginning of this study both groups were similar and comparable.

An interim of six school months passed since the giving of the pre-test of the avoidance-approach tendency questionnaire. In late April the post-test of the avoidance-approach tendency questionnaire was given to determine if any significant gains have occurred. Table 6 shows the results of the collected data.

Table 6

Mean Difference of Experimental and Control Groups on April Post-test of Avoidance-Approach Tendency Measure for Grades 1-6

Group	N	Obtained Means	Obtained *t*	Required *t*
Control (1)	29	20.81	.7338	2.000
Experimental	29	21.57		
Control (2)	30	21.60	.3090	2.000
Experimental	30	21.57		

The *t*-test of significance was used to analyze the data, and both the experimental and control groups show no significant difference in scores at the .05 level of confidence.

The two tables cited earlier show that no significant gains have occured. Statistical inferences can be made regarding the results even though the resulting gains were not significant.

Charted on the following page in Table 7 are the scores and frequency of responses obtained on the questionnaires given in October and April to the experimental group and the two control groups.

Table 7

Scores Obtained on the Avoidance-Approach Tendency Questionnaires in October 1969

Scores	Experimental Group	Control Group (1)	Control Group (2)
27-28		1	
24-26	9	7	5
21-23	10	10	13
18-20	5	6	6
15-17		4	3
12-14	4		2
9-11	1	1	1

A comparison of responses will be made using the results of Tables 7 and 8.

Table 8

Scores Obtained on the Avoidance-Approach Tendency Questionnaires in April 1970

Scores	Experimental Group	Control Group (1)	Control Group (2)
27-28	1	3	1
24-26	7	7	11
21-23	9	7	8
18-20	6	7	5
15-17	2	2	1
12-14	3		2
9-11		4	1

In Table 7 the responses with scores 18 or above show a positive response toward the area of mathematics as indicated by responses on the closed form questionnaire (see Appendix). Total responses below the score of 18 are considered negative responses. All groups have an 80 to 83 percent positive response toward the area of mathematics as analyzed in the October survey. When the questionnaire survey was taken in late April the negative responses were quite similar to the responses found in the October survey, but a shift into higher positive scores can be seen.

In the 24-28 score range, the experimental school had 31% of the respondents falling in that area for both the pre-test and post-test. The control school (1) had 27% of the respondents falling in the 24-28 range in October, and that increased to 33% in the April survey. A greater increase was shown in the control group (2). This group increased its scores in the 24-28 score range from 17% to 41%.

As can be seen from comparing Tables 7 and 8, all schools experienced gains in positive responses toward the area of mathematics.

TEACHERS' ATTITUDE TENDENCY QUESTIONNAIRE

A teacher questionnaire was given to make inferences about the similarity of teachers within this project as it pertains to: (1) area of concentration in college, (2) interest level in subject areas, (3) feelings about textbooks presently being used, (4) possible inferences about textbooks and effectiveness in teaching, and (5) views regarding the current mathematics program.

This five-question closed form questionnaire was given to the teachers in late April. Due to misreading of the first two questions, a number of responses could not be used. From the limited responses on these two questions, the generalization could be made that the experimental and control groups are comparable in regard to interests in the subject areas and college training.

The three remaining questions were answered correctly by enough of the responding teachers to be valuable in drawing inferences.

Table 9 (see Appendix) shows the responses of the teachers in the experimental and control groups to the closed form questionnaire. From these responses the following inferences can be drawn. The teachers in the experimental group using the Singer program textbook series seemed very satisfied with the text and their ability to teach effectively using it. Over three-fourths of the control group (1) and two-thirds of the control group (2) felt they could teach more effectively if they were using another series.

All groups seemed to have a majority of the teachers feeling that the newer contemporary mathematics program has increased their interest in the area of mathematics. No generalizations can be made at this time as to how it caused an increase in interest toward the area of mathematics.

The conclusions reached as a result of findings obtained in this study will be discussed in Chapter V.

CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY

The purpose of this study was to determine if achievement and attitude would be significantly changed by teaching using the Singer Mathematics program text as opposed to using the New Laidlaw Mathematics program. An experimental study was undertaken to make a comparison of students using each series. The results of the study are to be used as a criteria for curriculum decision making.

To make this comparison three schools in the Federal Way School District were involved. Two of the schools were the control groups. The other school was the experimental group. All factors in the study were left unaltered, with the exception of the experimental group. The teachers in the experimental school received information in a workshop regarding the Singer program series and how best to use it. In the control groups the teachers could teach out of the textbook series as well as supplement with other ideas if they desired.

In the two control and one experimental groups students were systematically drawn from a random sample in grades one through six. The number of students for each group ranged from 29 to 30 students. All classrooms in the schools involved in the study were represented and approximately five students were drawn from each grade.

A pre-test of achievement was administered in early October as well as the attitude tendency questionnaire. No significant differences were found to exist between the experimental and control groups. Following a six month interim, the achievement test and survey were given again to see if any significant gains occurred.

To test if any significant gains were made the writer used a shortcut *t*-test for comparing two independent sample means (15:289-334). The findings have been reported at the .05 level of confidence and required *t* scores were those taken from the Fisher and Yates Statistical Table (5:111).

CONCLUSIONS

Upon examining all the data in this experimental research project, several conclusions may be reached. First, in the area of achievement, statistically significant gains were made by the control group (2). Those gains were found to be significant at the .05 level of confidence but certain intervening factors have occurred which tend to influence these findings. The control group (2), which showed significant gains had its teachers attending a district workshop on the use of the Singer materials. They gained some ideas from this workshop and many have incorporated them into their programs. These were the materials being used by the experimental group. This particular school also had an administrator who stressed the importance of the mathematics area. These factors added to a possible sampling bias and sampling error influence the writer's accepting or rejecting the null hypothesis. As stated earlier the sampling for October and April were not entirely the same. Due to the changing school population a few alternate students were used in the sample. Due to not being able to identify the questionnaires one cannot be certain that sampling factors caused the loss or that there just happened to be a loss without any intervening factors such as sampling bias or error.

In the area of achievement, taking into account the possible intervening factors discussed above and the fact that both experimental schools did not experience significant gain, this study supports the null hypothesis:

> Student achievement does not increase significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics series.

A second hypothesis being tested was to determine if different textbook adoption can influence attitude changes. No significant difference in mean scores was found between the experimental and control groups in the pre-test of the avoidance-approach tendency measure. When the post-test of the avoidance-approach tendency measure was given again after an interim of six months, no significant differences were found in the number of students showing a positive tendency toward the area of mathematics.

The findings from the approach-avoidance tendency questionnaires substantiate the original null hypothesis:

> Student attitude toward the subject of mathematics does not increase significantly with the use of the Singer Mathematics program as opposed to the New Laidlaw Mathematics program.

RECOMMENDATIONS

This project was a two-year commitment being made by the school district, and this was the first year results of the study. This study will be tested and researched again in the following year.

The following are recommendations for future research:

1. To avoid sampling error and possible sampling bias, a larger sampling population is being recommended of at least ten students from each grade.

2. In order to keep the sampling true and exact for both the pre-test and post-test, a method of keeping track of the students should be devised. If there is

concern about students fearing identifying the survey material, assigning a number to each student in the sample may prove beneficial.

3. The student avoidance-approach tendency questionnaire should be revised and questions 4 and 5 rewritten or explained more clearly.

4. The teacher questionnaire should be reworded for questions 1 and 2. Also, more questions should be incorporated into the questionnaire.

5. The writer would recommend considering an achievement measure that tests reasoning, problem solving, as well as computational skills. If a wide range achievement test for grades one through six is not available or acceptable, perhaps a teacher or mathematics consultant-made test would serve the needs of this study.

6. Also recommended would be the testing of the additional two hypotheses involving teacher and parental attitudes that were not carried through in this study.

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APPENDIX

FORMULA USED FOR t-TEST OF SIGNIFICANCE

The following formula used to make the t-test of significance was taken from Mosteller and Bush's article, "Selected Quantitative Techniques" (15:289-334).

$$\underline{t} = \frac{(X_1 - X_2)\ (8\ \sqrt{n + 2.4} - 14.3)}{\text{Range}_1 + \text{Range}_2}$$

Table 9

TABULATION OF TEACHER ATTITUDE TENDENCY QUESTIONNAIRE

Question	Group	Total Responses	Very Much	Yes	No	Definitely No
Are you presently satisfied with the current mathematics text you are using?	Control (1)	18	1	3	5	9
	Control (2)	12	0	1	9	2
	Experimental	18	6	10	2	0
Do you think you could teach more effectively using a different series?	Control (1)	17	6	9	2	0
	Control (2)	16	6	6	3	1
	Experimental	18	0	2	14	2
Has the contemporary mathematics program increased your interest in teaching mathematics?	Control (1)	17	4	9	4	0
	Control (2)	14	5	7	2	0
	Experimental	18	7	7	4	0

WIDE RANGE ACHIEVEMENT TEST
Reading, Spelling, Arithmetic from Kindergarten to College
by Joseph Jastak and Sidney Bijou

Oral test given to first graders in October.

1. Count 1-2
2. Reads 3
3. Three fingers
4. Count 1-6
5. Count 1-10
6. Reads 5
7. 9 or 6?
8. 3 minus 1
9. Counts 1-15
10. Reads 6
11. 41 or 28?
12. Eight fingers
13. Reads 71
14. 4 plus 3
15. 9 minus 3

Oral test given to first graders in April.

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

3 5 6 17 41

3 fingers, 8 fingers

9 or 6?

42 or 28?

3 pennies, spend 1? _____

3 + 4 apples? _____

9 marbles, lose 3? _____

Written part.

$1 + 1 =$ _____ $\begin{array}{r} 6 \\ \underline{+2} \end{array}$ $\begin{array}{r} 5 \\ \underline{-3} \end{array}$

$4 - 1 =$ _____ $4 \times 2 =$ _____

$$\begin{array}{r} 32 \\ 24 \\ \underline{40} \end{array}$$

WIDE RANGE ACHIEVEMENT TEST
Grades 2-6

Add (+)

						48
						2853
	6		32		452	724
5	1	5	24	75	137	82
1	2	7	40	8	245	6215

Subtract (-)

8	5	14	84	745	6204	700904
0	4	8	36	368	530	9018

Multiply (X)

4	23	420	834	636	420.3	7.952
2	3	4	7	208	29	3.7

Divide (÷)

$4\overline{)8}$ $9\overline{)72}$ $6\overline{)968}$ $3\overline{)9.105}$ $31\overline{)6263}$ $5.2\overline{)572}$ $536\overline{)4762}$

Add (+) Reduce all fractions to lowest terms.

				6 1/5
	1/2		3 2/5	4
1/3	1/4	2 4/5	2 1/4	2/7
1/3	1/8	7 2/5	1 5/6	9 4/5

Subtract (-)

7/8	4 2/3	8	7 1/6	19 1/5
3/8	2 2/3	1 3/5	3/4	14 2/3

Multiply (X)

3/4 x 4/5 = 2/3 x 9 = 5/8 x 6/7 =

4 3/8 x 2/3 =

25 1/2
16 3/4

Subtract	Divide	Average	Express in %	Write as a common fraction
7 x y 3 x y	$1/2 \div 3/4 =$ $7/8 \div 3\ 2/3 =$	26 45 97 82	$3/4 =$ $.45 =$ $7/100 =$	 $3\% =$ $66\ 2/3\%$

Write as a decimal fraction	Find		Solve
$4\ 1/2 =$ $3/5 =$ $9/100 =$	120% of $20 =$ $2/3\%$ of $300 =$ 2.3% of $40 =$	What % of 60 is 15? Ans.________ 6 is 20% of what number? Ans.________ 30 is what % of 200? Ans.________	$(-5)(+9) =$ $(3)^3 =$ $(4^2)^2 =$ $(25)^{1/2} =$

Solve for X	Solve for x	Reduce	Find square root
7:28::12:X	$x-4(6-7x)=34$	$-28y+(-3y)$	$\overline{1764}$

Factor	Divide	Solve for x and y	Solve for a	Reduce
$X_2-7X+12$	$a^7 \div a^2$	$x + y = 8$ $3x + y = 4$	$\frac{a+3}{a-3} = \frac{a+4}{a-6}$	$\frac{a-b}{a^2+b^2} \cdot \frac{a^4-b^4}{(a-b)^2}$

Find the simple interest on \$1000 for 36 days at 4%

Ans. __________

If the base of the logs is 10,

$\log 10^5 =$ $\qquad$ $\log (1/100) =$ $\qquad$ $\log (10 \times 100) =$

SCHOOL: ________________ TENDENCY QUESTIONNAIRE 3+ *
MATHEMATICS CONSULTANT
DATE: ________________ FEDERAL WAY SCHOOL DISTRICT 210

ANSWER THE FOLLOWING QUESTIONS OR FOLLOW THE INDICATED DIRECTIONS HONESTLY AND ACCORDING TO YOUR FEELINGS. DRAW A CIRCLE AROUND YOUR RESPONSES. YOU WILL NOT BE GRADED.

---

1. How interested are you in taking another course in mathematics?

   a. Very interested
   b. Interested
   c. Don't care one way or the other
   d. Not interested

2. I find the subject of mathematics (complete this sentence with your choice of item below.)

   a. Very interesting
   b. Somewhat interesting
   c. Somewhat uninteresting
   d. Very uninteresting

3. How interested are you in learning more about mathematics?

   a. Very interested
   b. Somewhat interested
   c. Don't care one way or the other
   d. Not too interested

4. For each of the following pairs of subjects, draw a circle around the subject that you personally find the more interesting of the two.

   a. Mathematics - English
   b. Social Studies - Mathematics
   c. Science - Mathematics
   d. Mathematics - Music

5. Circle each of the words that describe how you feel about mathematics.

interesting	fun	useful	exciting
dull	boring	useless	scary

*Form used in Grades 4, 5, and 6

6. Do you use spare time to work on or read about mathematics?

   a. Often
   b. Sometimes
   c. Seldom
   d. Never

7. Do you like mathematics?

   a. Very much
   b. Yes
   c. No
   d. Definitely not

SCHOOL: ____________________

DATE: ____________________

TENDENCY QUESTIONNAIRE 3- *
MATHEMATICS CONSULTANT
FEDERAL WAY SCHOOL DISTRICT 210

LISTEN AND FOLLOW DIRECTIONS CAREFULLY

1. Would you like to have math in every grade?

___ YES ___ DON'T CARE
___ NOT SURE ___ NO

2. I think mathematics is:

___ FUN ___ WORK
___ FUN SOMETIMES ___ HARD WORK

3. Do you want to learn more about math?

___ YES ___ I DON'T CARE
___ I GUESS SO ___ I DON'T WANT TO

4. Which would you rather do?

___ WRITE STORIES or MATHEMATICS ___
___ READING or MATHEMATICS ___
___ MATHEMATICS or ART ___
___ MATHEMATICS or MUSIC ___

5. Do you think mathematics is:

___ INTERESTING ___ FUN
___ EASY ___ EXCITING
___ TIRING ___ TOO LONG
___ HARD ___ BORING

6. When you have spare time do you play with mathematical things or work problems?

___ OFTEN ___ SELDOM
___ SOMETIMES ___ NEVER

7. Do you like mathematics?

___ VERY MUCH ___ NO
___ YES ___ DEFINITELY NOT

*Form used in Grades 1, 2, and 3

SCHOOL ______________ **INTEREST LEVEL** QUESTIONNAIRE

DATE ______________ K-3 - 4-6 - Secondary

Presently a curriculum study project is being conducted in the district. We would appreciate your answering the following questions or follow the indicated directions honestly and according to your feelings. Draw a circle around your responses. This questionnaire is not being used to evaluate or judge you as a teacher.

---

1. Which subject of each pair do you enjoy teaching the most?

   a. English or Mathematics
   b. Science or Mathematics
   c. Mathematics or Social Studies
   d. Mathematics or Reading

2. Which, of each pair, do you feel most competent to teach?

   a. English or Mathematics
   b. Science or Mathematics
   c. Mathematics or Social Studies
   d. Mathematics or Reading

3. Are you presently satisfied with the current mathematics texts you are using?

   a. Very much
   b. Yes
   c. No
   d. Definitely not

4. Do you think you could teach more effectively using a different series?

   a. Definitely
   b. Yes, I think so
   c. No, I don't think so
   d. Definitely not

5. Has the contemporary mathematics program increased your interest in teaching mathematics?

   a. Very much
   b. Yes
   c. No
   d. Definitely not